
Space Weather Technical Forecast

Issued on Sunday, 22 May 2022 at 13:03 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Chance of R1-R2 Radio Blackouts.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has remained Low over the past 24 hours, with the background X-ray flux measured at GOES16 remaining in low C-class with only minor isolated flares.

There are now up to nine sunspot regions on the Earth-facing side of the sun. These include the ever-present AR3014, which retained its Ekc/Beta-Gamma-Delta classification, however it showed little overall growth or changes, with no flares recorded. While on paper less potent, the rapid growth trend of AR3017 to the east made it one to watch, although this, too, proved relatively unremarkable in the period, reaching Eai/Beta. The only other growth was seen in AR3011 in the west, however this also remained quiet with a final presentation of Bxi/Beta. Although unnumbered at present, the eastern solar horizon saw the arrival of up to two groups, a unipolar Hsx in the southeast and a bipolar Dro in the northwest, with this latter group likely to reveal more detail as the viewing angle improves.



Figure 0: Helioviewer.org-generated image composite of AIA 171, HMIB and HMIIF for 22/1000UTC, showing AR3017 lower left and AR3014 upper right and their magnetic structure. Also shown inset is the Earth for scale.

Coronagraph imagery in the past 24 hours revealed some notable events, not least a southward-directed partial halo CME, however this was determined to be far-sided to no effect at Earth. No Earth-directed CMEs were observed in available imagery in the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE and DSCOVR at L1, was reflective of a very slowly waning fast wind from CH82/+, and as such the phi angle was mainly positive (away from the sun) throughout.

The solar wind speed gradually fall from early elevated highs of around 525km/s, falling as low as around 450km/s before a late rally into the upper-400s of km/s. The solar wind density recorded differed between the two satellites, but remained at background in single-figures ppcc. The IMF was level, with a peak of 6nT and a north-south variation of +4/-5nT.

The net result of the above solar wind measures was provisionally Quiet to Unsettled geomagnetic activity, with a solitary peak of Active 4o in the 00-03UTC interval.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) has been at Background levels through the last 24 hours.

The high energy electron flux (greater than 2 MeV) rose to Moderate levels, peaking at 931ppcc at 21/1655UTC, as a result of the fast wind from CH82/+. Despite this the corresponding electron fluence remained below the Active threshold (1e8 integrated pfu) with a rising then level trend to reach 2.4e7 integrated pfu at 22/0001UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity carries a daily Chance of reaching Moderate, with R1-R2 radio blackouts most likely from AR3014 but also perhaps from AR3017 given its recent growth.

A large CME has been observed leaving the far side of the sun earlier, indicating the presence of one or more active regions. This is also confirmed by bright flux regions visible on STEREO A EUVI195 imagery. These will need to be closely monitored over the next few days, as they gradually emerge over the eastern limb.

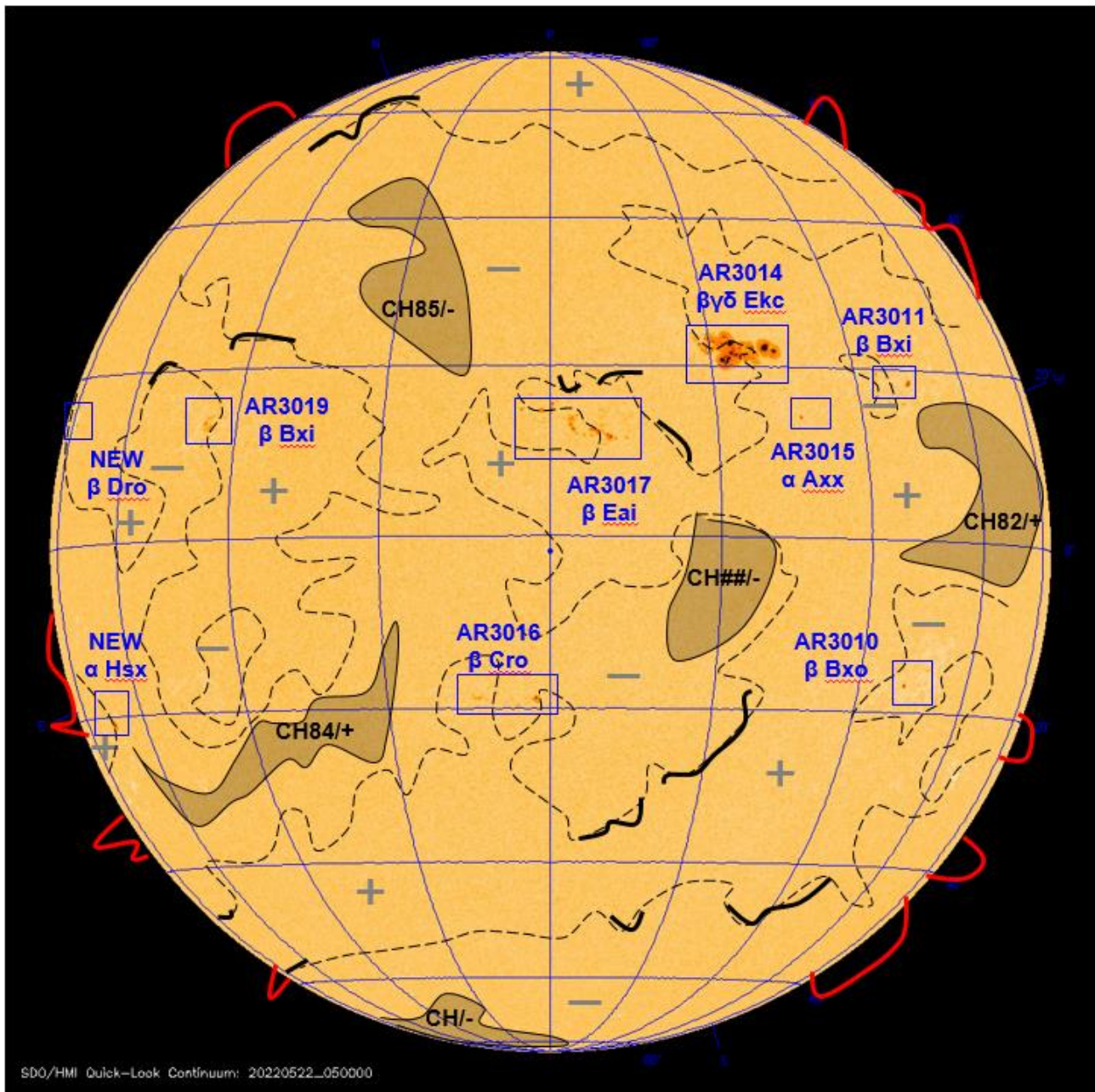
Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are currently expected.

Solar winds are now under the waning influence of coronal hole 82 and expected to return to ambient levels over the following days. They might become slightly enhanced as a result of a possible tenuous coronal hole on day three (Tuesday 24 May) but any impact on geomagnetic conditions should remain minor and brief. Geomagnetic activity is therefore expected to be mostly Quiet through the coming four days.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is expected to be at Background levels during this period, but with a daily Slight Chance of flux reaching S1, should any notable flares occur.

The high energy electron flux (greater than 2 MeV) is forecast to fluctuate between Low and Moderate levels, perhaps exceeding 1000pfu during the diurnal peak. The 24-hour electron fluence will most likely remain below the Active (1e8 integrated pfu) threshold during the forecast period, albeit with an early-week rising trend.

Figure 1. Solar Analysis Valid 22/0500UTC.



Key: Filament ____, Prominence ____, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α - β - $\beta\gamma$ - $\beta\gamma\delta$ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

A few CMEs were observed on satellite imagery in the last 24 hours, but analyses have revealed that none of them are thought to be Earth-directed.

The current fast speed stream emanating from CH82/+ is on the decline, with speeds now slightly elevated but decreasing. With no other significant coronal features in the western solar hemisphere, winds should continue to decline and revert to slow-ambient levels.

A small negative coronal hole may have developed near the solar equator but the proximity to EUV flux loops of two sunspot regions nearby is making the assessment difficult. However the past 2.5 days of STEREO A MAG and PLASTIC measurements do not suggest any significant departure from a slow regime going forward, and any small coronal hole here is therefore unlikely to cause any significant impacts on geomagnetic activity.

Finally, the other coronal holes visible on the Earth-facing disc, namely CH84/- and CH85/-, are further east and their respective fast speed streams not expected to become geoeffective during this period.

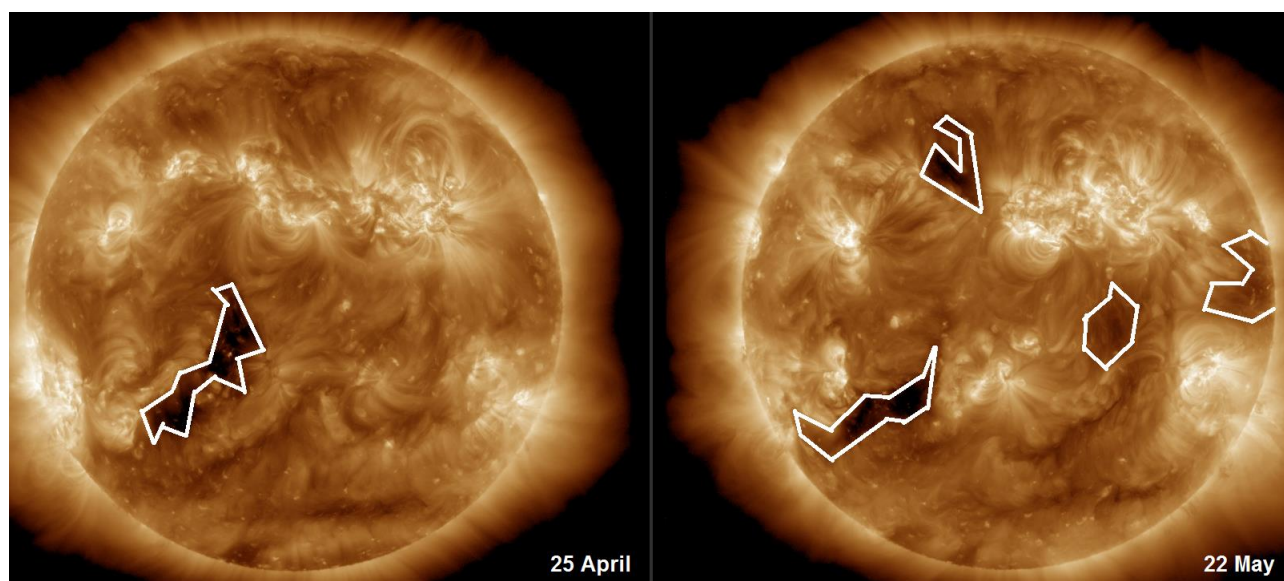
With the above in mind, geomagnetic activity is expected to see some Unsettled periods at first, perhaps with an outside chance of the odd Active interval, but increasingly return to Quiet levels early in the new working week UTC.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: Differences in coronal hole geometry for the past and current rotations. The current coronal hole, CH82/+ can be seen far right, there is then a tenuous unnumbered feature to its immediate east, followed by the negative polarity pair of CH85 and CH84, with both/either perhaps due later this working week UTC.



Radio Blackouts - X-Ray Flares:

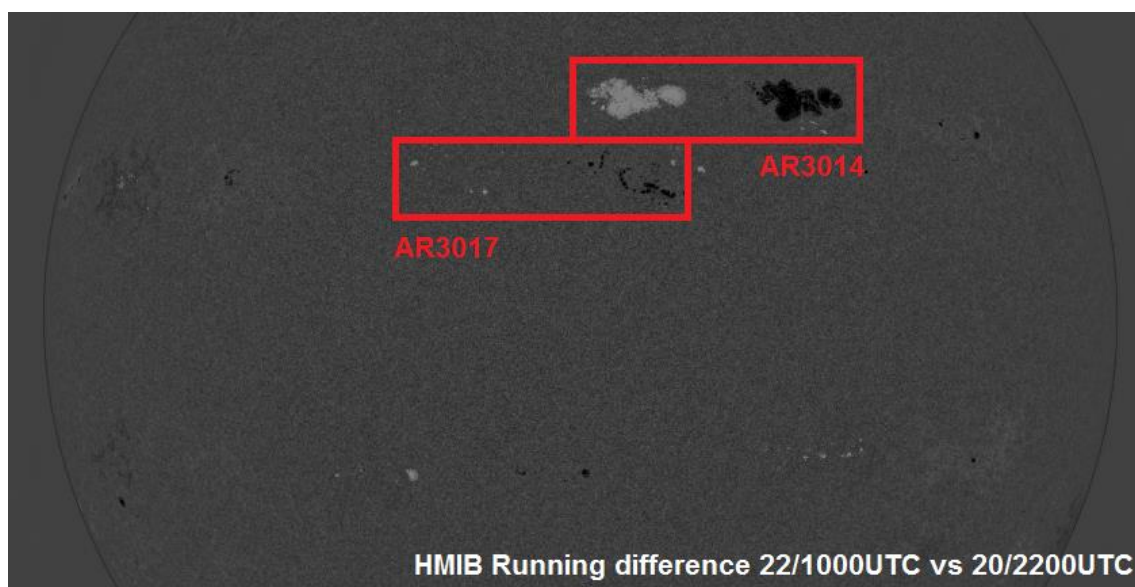
There are now up to nine sunspot regions on the Earth-facing disc. Somewhat counter to the current presentation of AR3014 and perhaps 3017, GOES16 X-ray activity has become very muted in the past 36 hours or so, probably a result of the spots' maturity, as their raw Zurich class suggests flares are much more likely than is currently being borne out. The chances of both M-class and X-class flares have both been revised slightly downwards to account for observations as a result.

AR3014 is expected to leave the disc on Thursday 26 May, and this ought to be a catalyst for a step-wise decrease in the risk of X-ray flares, even if the chances of proton storms persist a while longer onto the far side.

A large CME has been observed leaving the far side of the sun earlier, indicating the presence of one or more active regions. This is also confirmed by bright flux regions visible on STEREO A EUVI 195 imagery. These will need to be closely monitored over the next few days, as they gradually emerge on to the eastern limb. A couple of large filaments also currently occupy the western solar hemisphere and any lift-off in the near-term could potentially be Earth-directed.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: Helioviewer.org processed running difference imagery, showing growth in AR3017 (compare white sunspots with black in red-boxed area); note also the now stabilising AR3014.



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is at Background levels and is most likely to remain so through the period.

The daily risk of surpassing S1 should very slightly increase over the four-day period, although the raw probability is close to 10% throughout and this figure is therefore used for all days of the period. This risk is the result of the westward progress of the largest and nominally most complex region on the disc, although despite some M-class activity, this has not yet proven to have delivered any proton enhancement at Earth.

Radiation Storms	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{s}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Probability (Exceedance)						
Active	$\geq \text{S1}$	No	10	10	10	10
Very Active	$\geq \text{S3}^*$	No	1	1	1	1
* S3 $\geq 10 \text{ MeV} \geq 1000 \text{ pfu}$ and / or $\geq 50 \text{ MeV} \geq 10 \text{ pfu}$. (pfu = $\text{cm}^{-2} \text{sr}^{-1} \text{s}^{-1}$)						

High Energy Electrons Event ($\geq 2\text{MeV}$):

The high energy electron flux (greater than 2 MeV) rose to Moderate levels, peaking at 931ppcc at 21/1655UTC, as a result of the fast wind from CH82/+ charging the radiation belts. It is expected to fluctuate between Low and Moderate levels over the next few days, perhaps exceeding 1000 pfu during the diurnal peak at times.

On the previous rotation, the fast solar wind regime proved incapable of resulting in Active 24-hour integrated electron fluence. The current solar wind enhancement from CH82/+ is slightly enhanced in comparison, so while flux may increasingly trouble the High boundary, on balance it should most likely average out below Active, even as geomagnetic activity from CH82 wanes into the forthcoming working week.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	No	20	30	20	10
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1